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TRANSPORTATION BY RAILCARS: A STUDY OF OPTIONS

By

M. Provencher

MARCH 1998

OTTAWA, CANADA



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ABSTRACT

Currently the Canadian Forces (CF) use railcars from railway companies to transport materiel over long distances. In the last couple of years the availability of railcars has been lacking. During the recent Manitoba floods in the spring of 1997, some vehicles had to be driven to their destination. This paper presents a study of the CF past usage of railcars and an analysis of different cost options. It shows that the CF should be guaranteed a minimum of 48 (60 foot long) railcars in order to be able to respond to 60% of the demand.

RÉSUMÉ

À l'heure actuelle les Forces canadiennes (FC) utilisent des wagons de compagnies de chemins de fer pour transporter du matériel sur de longues distances. Dans les deux dernières années la disponibilité des wagons a fait défaut. Durant les récentes inondations au Manitoba au printemps 1997, des véhicules ont dû être conduits à destination. Ce document présente une étude de l'usage passé des wagons par les FC ainsi qu'une analyse de différentes options financières. On montre que les FC devraient se faire garantir un minimum de 48 wagons (de 60 pieds de long) de manière à pouvoir répondre à 60% de la demande.

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TRANSPORTATION BY RAILCARS: A STUDY OF OPTIONS

L INTRODUCTION

1. Much of Canada's history and development is tied to the history and development of rail. Canada was stitched and held together by railway. In the military sense Canada has not had to rely on the railways for her own survival, however, railways have been used for military purposes for the mass movement of materiel and troops. Troop trains were commonly used in Canada during World War I to transport troops and horses to locations such as Camp Borden and Camp Valcartier for training prior to embarkation for Europe. Similarly in World War II railway trains moved troops, equipment and stores to eastern ports and garrison sites. From World War II onward railways began playing a decreasing role in the nation's affairs including Canada's military affairs [1]. The automobile, the transport truck and the airplane have taken over a lot of the railways market. However railways are still used by the Canadian Forces (CF) essentially for the mass movement of materiel.

2. The CF have been using railcars mainly through Canadian National or Canadian Pacific, hiring them as needed. A whole chapter of the CF Transportation Manual, Volume 4 [2] is dedicated to shipment via rail. In the last couple of years, the availability of railcars from the two major Canadian companies has been failing. Railcars are used at the maximum of their capacity, or so it seems. This showed during Exercise Venom Strike in 1995 and again more recently during Operation Assistance in the spring of 1997 when the Winnipeg area suffered severe floods. There were not enough railcars to get on location in time, so several of the vehicles were driven to their destination.

3. This report presents the results of a study of past usage of railcars by the CF and an analysis of rail services options including long term leases and the purchase of railcars by the CF. At stake, of course, is the CF's capability to respond in a timely fashion when an operation is called. This study was sponsored by J4 Mov [3].

II. ANALYSIS OF PAST DATA

4. Prior to looking at various railcar services to ensure a CF timely response to an operation, there is a need to understand better the use that has been made of this transportation mode in the recent past. To this end, all rail transport over the last five fiscal years (FY)¹ i.e. FY 92-93, FY 93-94, FY 94-95, FY 95-96 and FY 96-97 plus Operation Assistance were analysed. The results follow.

5. Railcars are used by the CF for different purposes i.e. operations, exercises and any other general use. Figure 1 represents the number of railcars used for each purpose or activity. Exercises represent by and large the most common use of cars i.e., 81% of the number of cars used over some five years, while operations used 17% of them and 2% were used for other purposes.

6. In order to fulfil its commitments the CF have to be able to provide transportation for operations and exercises in a timely manner. Railways provide the best transportation alternative for the mass movement of materiel over long distances: everything is kept together and it is cheaper than any other means of transportation [2,7]. CF tracked vehicles cannot be driven to their destination because they would seriously damage the roads and reduce their useful life. The railcars that the CF have been using are standard flatcars (60 foot, sometimes 89 foot long, chain-tie-down type) which make it quicker and easier to secure army equipment. This is also what the United States (US) forces used: during Operation Desert Storm, 13 446 railcars were used in the movement of materiel, 90% of which were flatcars [4]. The current usage made of railcars is not so much in question here, as the manner in which the CF could guarantee themselves the availability of a number of railcars at a reasonable cost. "How many railcars should be guaranteed" and "What would be the most cost effective service" are the questions asked. Incidentally, railroads are also the safe way to move freight, with a fatality rate of one third that of the trucking industry and they are the safest way to move hazardous materiel, such as ammunition [5].

¹ A fiscal year within the Government of Canada starts on April 1st of one year and ends on March 31st of the following year.

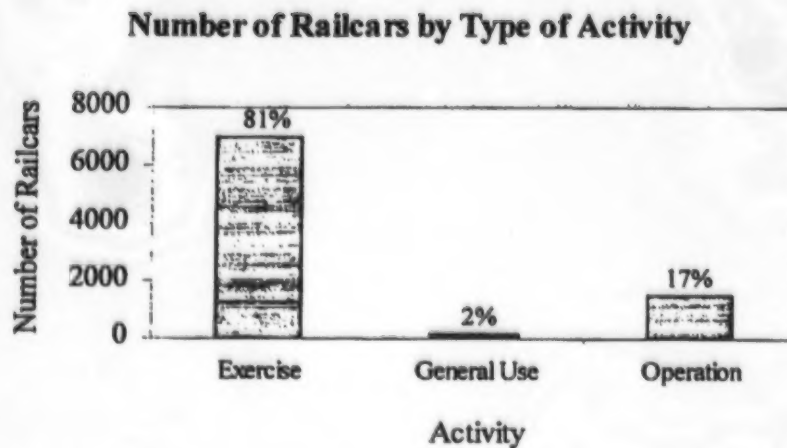


Figure 1: Histogram of Railcars by Activity (covering the last 5 years)

7. The following histogram, see Figure 2, illustrates the number of railcars used for various exercises and operations over the last five years. The last major events since Rendez-vous 92 (RV 92) have been Exercise Venom Strike in 1995 in Gagetown and Operation Assistance in the spring of 1997 in Winnipeg. The histogram shows the number of railcars used to get to the exercise or operation and the number of railcars used to come back. Clearly in these last two major events, the number of railcars used for deployment was smaller than the number used for re-deployment: in both instances the availability of railcars was lacking in the deployment phase when timeliness is crucial. It would have been interesting to analyse the lead time given in procuring the railcars but this information was not on record.

8. The maximum number of railcars used for deployment or re-deployment for a given exercise or operation was used as the best parameter to determine the Canadian Forces requirement in terms of number of railcars. A cumulative distribution of that variable shows that if we had or were guaranteed 179 railcars, we would satisfy the CF's requirements 85% of the time. That is, on the basis of past exercises and operations, if the CF had 179 railcars available, 85% of the time they would have enough to answer the demand. If the CF were to lower their expectations and be happy with meeting the demand say 60% or 70% of the time that would correspond with 48 and 66 railcars respectively. Of course the more confidence one wants in meeting the demands, the more one will have to pay (literally) in resources availability i.e. railcars (Figure 3).



Figure 2: Number of Railcars per Exercise/Operation

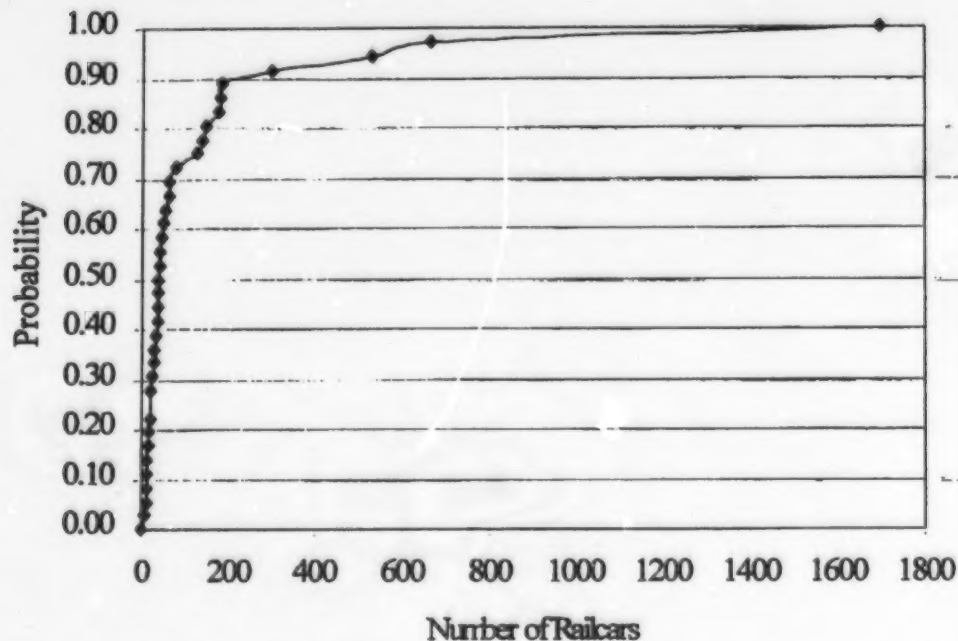


Figure 3: Cumulative Distribution of the Maximum Number of Railcars Needed for an Exercise or Operation (one way)

9. It is important to point out that the requirement in railcars is based on operations and exercises when the concern is on timely response to operations. There was not enough data on operations alone to analyse them separately. For a level of confidence at 70% the CF would need a relatively small number of railcars i.e. 66. That, we know, is all that would be needed (or less) 70% of the time when an exercise or operation occurs. But what if two such events occur at once? Would all needed railcars be available? Figure 4 shows the cumulative distribution of the total number of railcars needed per month on the basis of five years of data. 70% of the time the number of railcars used in a month is 97 or less (one of these railcars being for general use). Thus railcars are not used that frequently. The number of railcars determined to meet the requirements of an exercise/operation would most likely suffice to meet all exercises/operations requirements within a year. Specific numbers for given probabilities are provided in Annex A for the number of railcars needed in an exercise/operation, per month, etc.

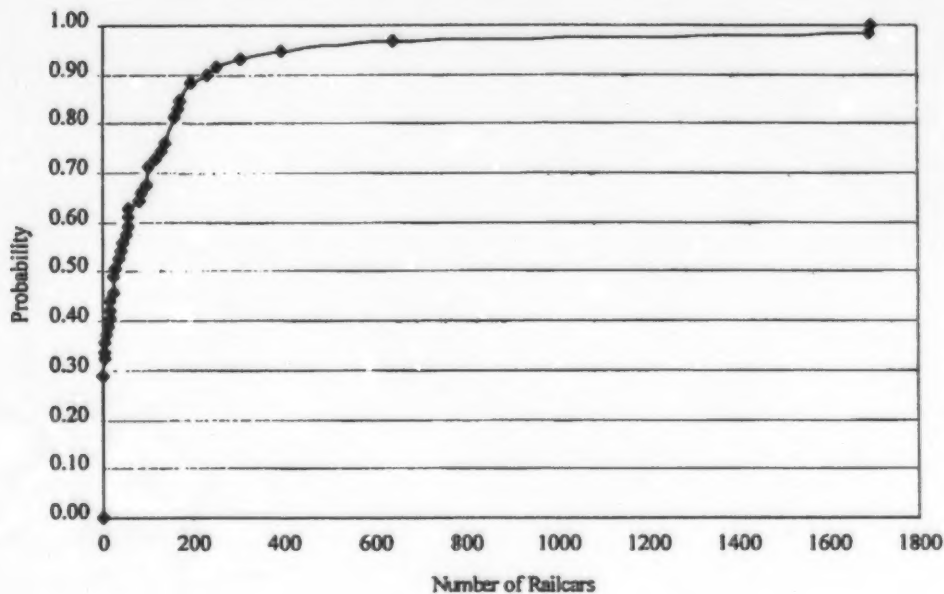


Figure 4: Cumulative Distribution of the Number of Railcars Used per Month

10. In terms of geographical locations or where the requirement in railcars is, seven locations were identified on the basis of either the number of in and out shipments and/or the number of in and out railcars over the five-year period plus Operation Assistance. The criteria determining the most important locations were whether the number of railcars coming in or out exceeded 1000 over the five-year period or the number of in or out shipments exceeded 20 over that same period. The locations were: Chilliwack, Gagetown, Montréal, Petawawa, Valcartier, Wainwright and Winnipeg. The following two histograms and map illustrate the importance of those locations (see Figures 5, 6 and 7).

11. If the CF were to own a number of railcars, consideration should be given to one of those seven locations as a holding area. It would be worthwhile before choosing any to verify that no major changes affecting the requirement in railcars have occurred recently. It might also be preferable to split the number of railcars between the eastern and western parts of the country to make some railcars more readily available if an operation was suddenly declared.

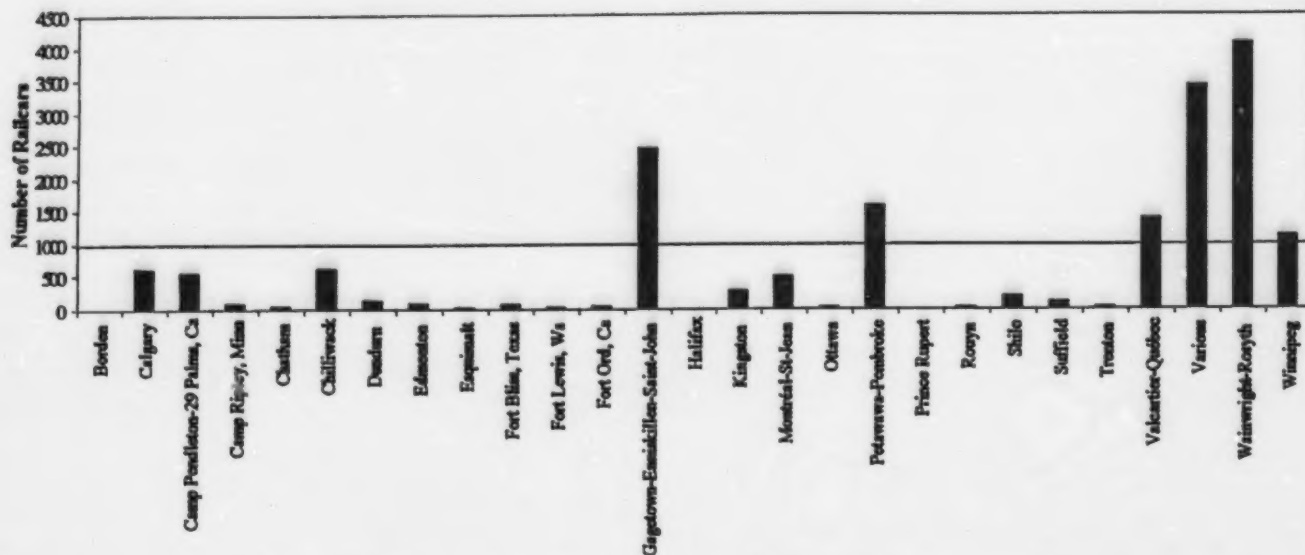


Figure 5: Histogram of the Number of Railcars per Location
(over last 5 years, in deployment/re-deployment)

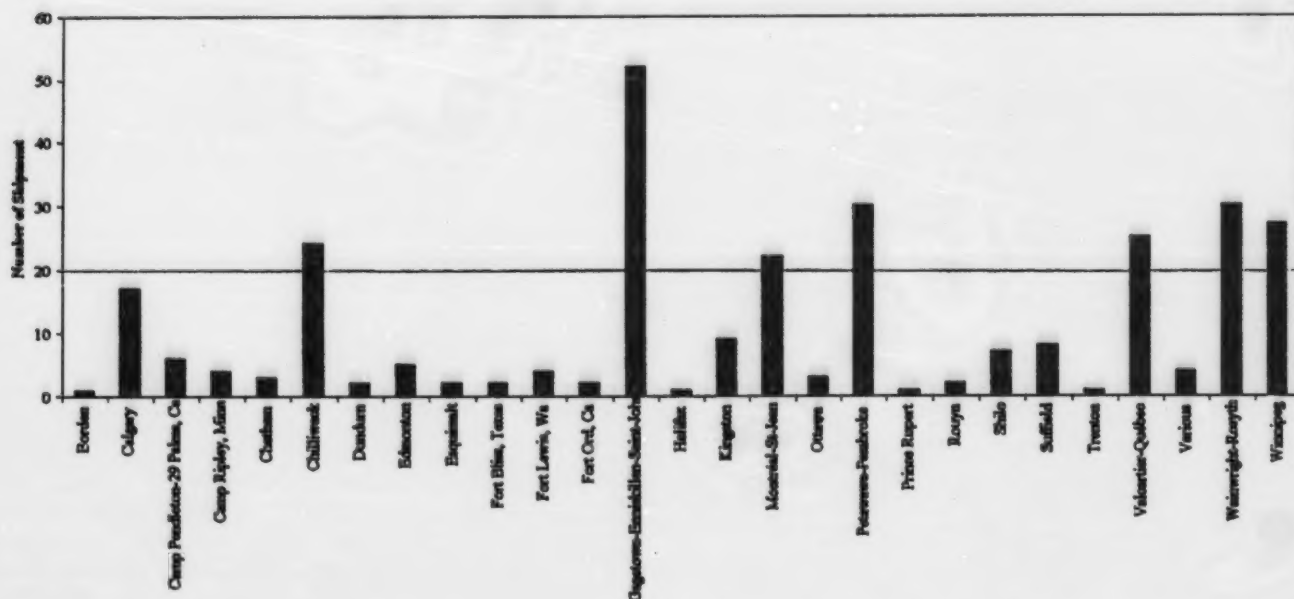


Figure 6: Histogram of the Number of Shipments per Location
(over last 5 years, in deployment/re-deployment)

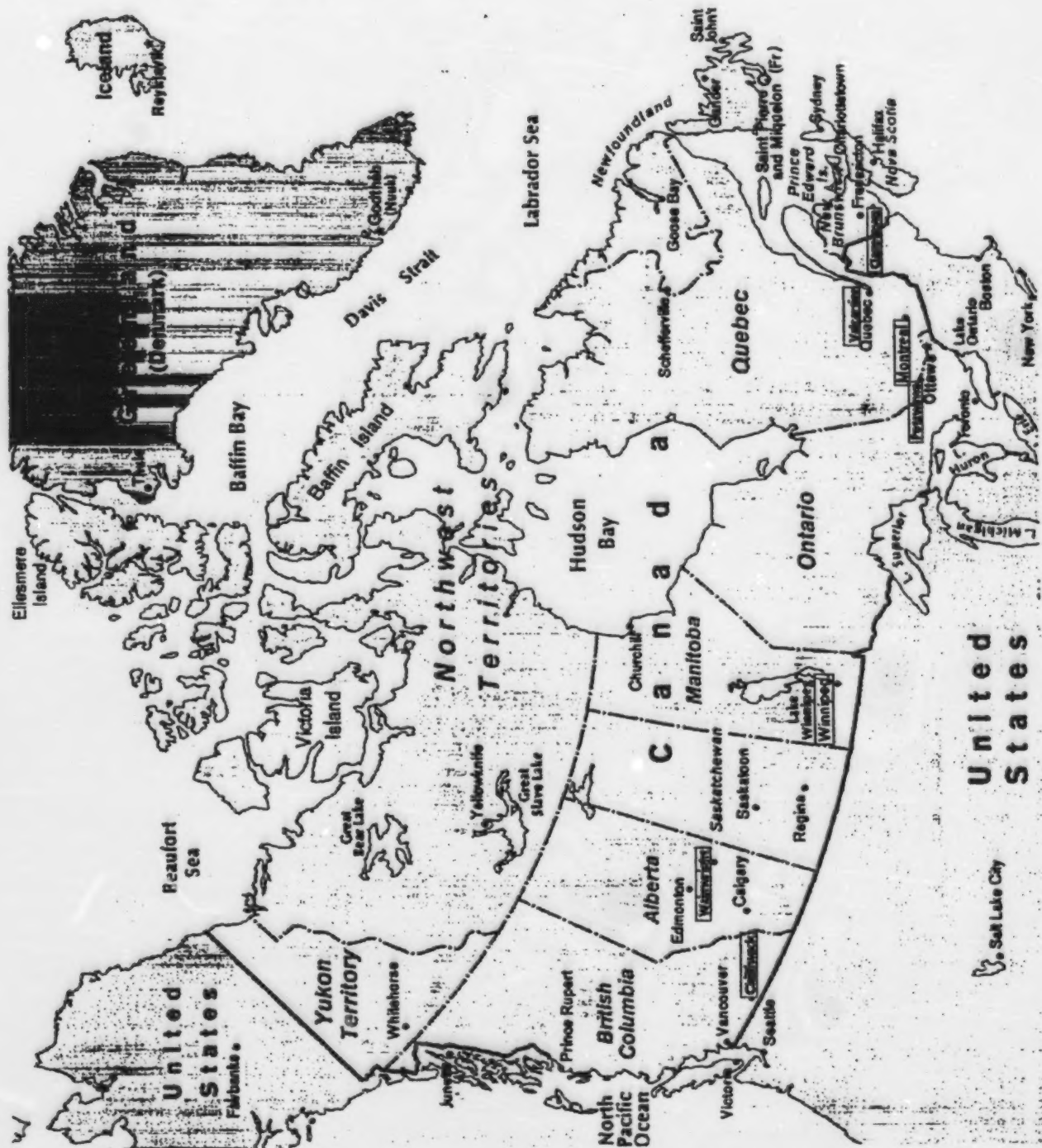


Figure 7: Map of Canada indicating the Seven Locations

12. Of course if the CF were to own railcars, an efficient use of these would be desirable. The following graph (Figure 8) illustrates the median monthly number of cars used per year on the basis of FY 92-93 to FY 96-97 i.e. five years. The monthly median means that for a given month 50% of the time the number of cars used is below that value, 50% of the time it is above. The medians provided in Figure 8 are based each on 5 observations only (5 years), so it is not very accurate but does provide good indications of busy and not so busy periods within a year² (the vertical lines represent the inter-quartile range around the median i.e. the spread of 50% of the values around the median).

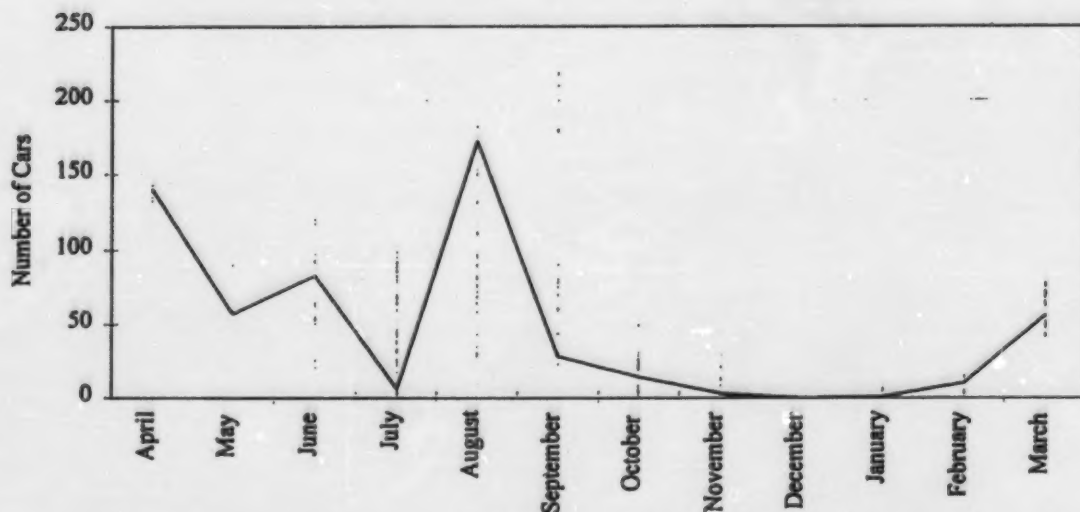


Figure 8: Median Number of Cars per Month over Five Fiscal Years

13. Noting the months where CF's railcars are most likely or less likely to be used, one sees that the CF's activities culminate in the spring and at the end of the summer. To make good use of the railcars on other months, particularly from October to February, the CF would have to consider offering to lend them to others. The CF could not lease their railcars to potential customers of railway companies. The government of

² Note that a larger sample would not necessarily help, since one does not want to make today's decisions on the basis of dated information.

Canada³, by policy, does not compete with the industry. The CF could however lease their railcars to the railway companies themselves.

14. In analysing the costs incurred over the past five years, particular attention was given to the factors that might be affecting them. Costs are provided in terms of dollar amount per railcar for a given shipment from point A to point B. The hiring cost per car is all encompassing, it includes; the cost of having the railcar in possession, transport, administration, etc. Using the data from FY 92-93 to FY 96-97, these cases where the costs were expressed in American or United States (US) dollars were converted into Canadian (CAD) dollars following the actual rate of exchange of the fiscal year [6]:

TABLE II
RATE OF EXCHANGE TO APPLY TO AMERICAN DOLLARS

FY 92/93:	1.2296
FY 93/94:	1.3094
FY 94/95:	1.3820
FY 95/96:	1.3631
FY 96/97:	1.3609

Out of the 147 observations or shipments made over some five years, the median cost per car was found to be \$1975 while the average was a bit more at \$2541. The reason for the average being larger than the median is that the cost distribution has a wide spread of large values as can be seen from Figure 9. The frequency represents the number of observations per category. For example in bin 1000 there are 20 observations i.e. 20 shipments for which the cost per car was lower or equal to \$1000.

³ Telephone conversation between M. Provencher and LCol P. McCaffrey, D Law M, dated 26 January 1998.

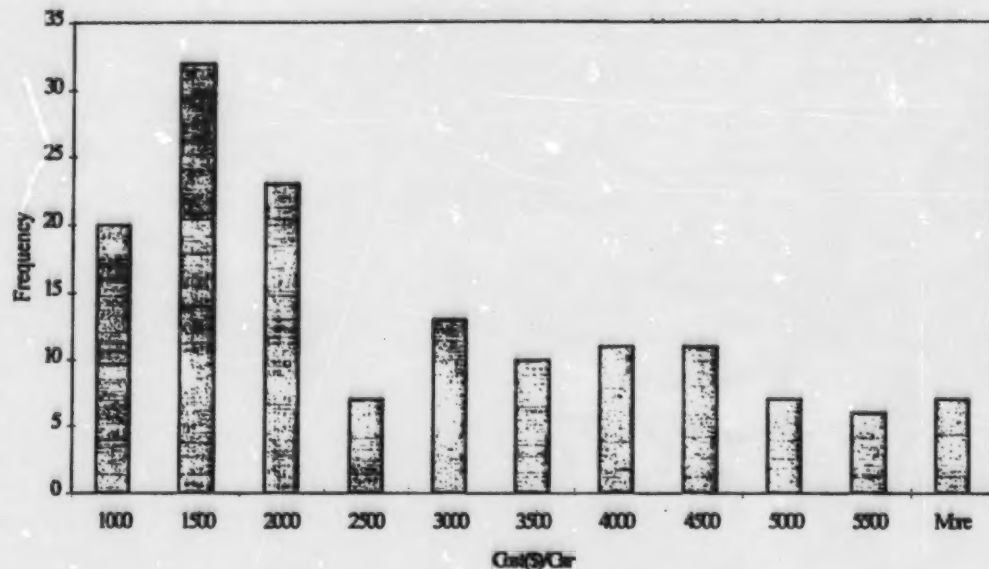


Figure 9: Histogram of the Cost(\$)/Car

15. These observations analysed separately for each railway company that the CF dealt with shows that there is not much difference between the two main companies i.e. Canadian National (CN) and Canadian Pacific (CP). Boxplots by railway companies can be found on Figure 10. A "box" contains 50% of the data, the longer the box the more spread out the distribution is. The averages for CN and CP are not significantly different (statistically). CN has a median lower than that of CP however its costs vary more widely. In fact a Kruskal-Wallis test with the hypothesis that the location of the two distributions (CN and CP) are the same cannot be rejected (if rejected the probability of error would be 0.82).

Variable=CSTWAG

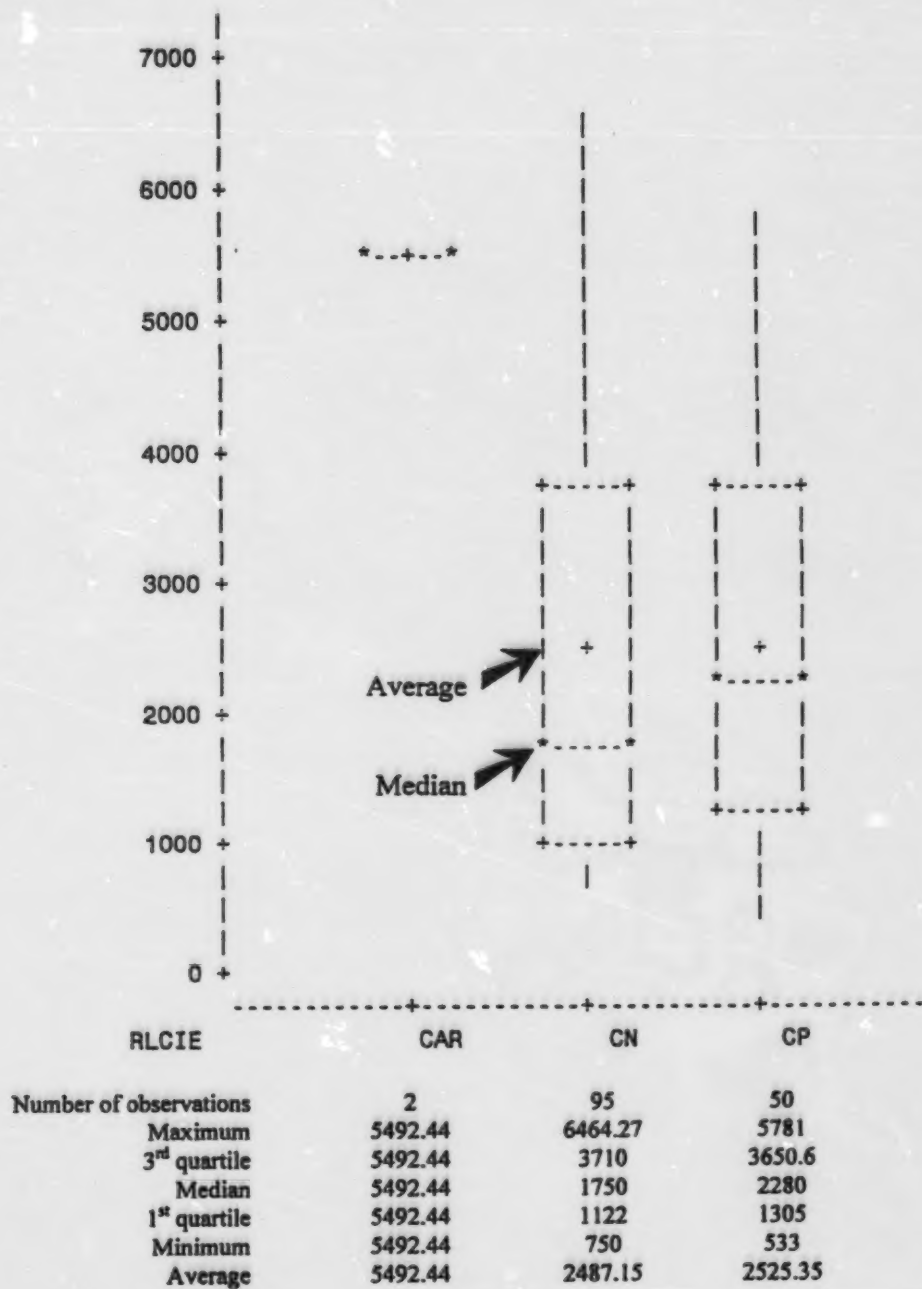


Figure 10: Boxplots of Cost(\$)/Car per Railway Company

16. Thus far we have observed that there is a lot of variation in prices and that whether one railway company or another is used, there is no significant difference in cost. Other factors have been looked at such as the origin of the shipment, the destination, the number of cars per shipment and the date of the shipment. An analysis of variance on the cost per car with these parameters showed that the combination of origin and destination (accounting for the distance travelled) and the date explain 97% of the variance in the cost: the R^2 was 0.9708.

17. The Pearson correlation coefficient between all the quantitative variables was calculated (see Table II). It was found that the date and cost per car are positively correlated while the date and the number of cars per shipment are negatively correlated. Thus it appears that as time goes, prices go up as one would generally assume, but as time goes, the number of cars per shipment diminishes. The latter case may be a reflection of the lack of availability of cars and a reflection of a diminishing need (no more RV). On the other hand the cost per car and the number of cars are not correlated. The idea that a larger quantity would lower the cost per unit is not valid here probably because of the demand in railcars.

TABLE II
CORRELATION COEFFICIENTS

	Date	Cost per Railcar	Number of Railcars
Date	1.00	0.35 0.0001*	-0.26 0.0015
Cost per Railcar		1.00	-0.03 0.7158
Number of Railcars			1.00

**probability of error if the hypothesis that the correlation is null is rejected*

18. This completes the analysis of the recent past on the Canadian Forces usage of railcars. It has provided estimates of the number of railcars needed to meet given levels of confidence in accomplishing the tasks. The following section will try to identify what is the best financial option to meet these requirements.

III. OPTIONS ANALYSIS

19. In the last five years plus Operation Assistance, the total cost per year in railcar usage has been varying substantially. Figure 11 illustrates these costs in constant dollars i.e. in the dollars of the fiscal year they were incurred. Note that FY 97-98 represents only the costs incurred for Operation Assistance. It is also important to stress that FY 92-93 was the last fiscal year where a full scale Rendez-vous took place. Even though the occurrence of exercises and their particular transportation needs can be forecasted from one year to another, the occurrence of operations cannot. The cost so far in FY 97-98 has already exceeded that of the previous year. The median for all these values is 2.79 million \$ or 2.79M\$.

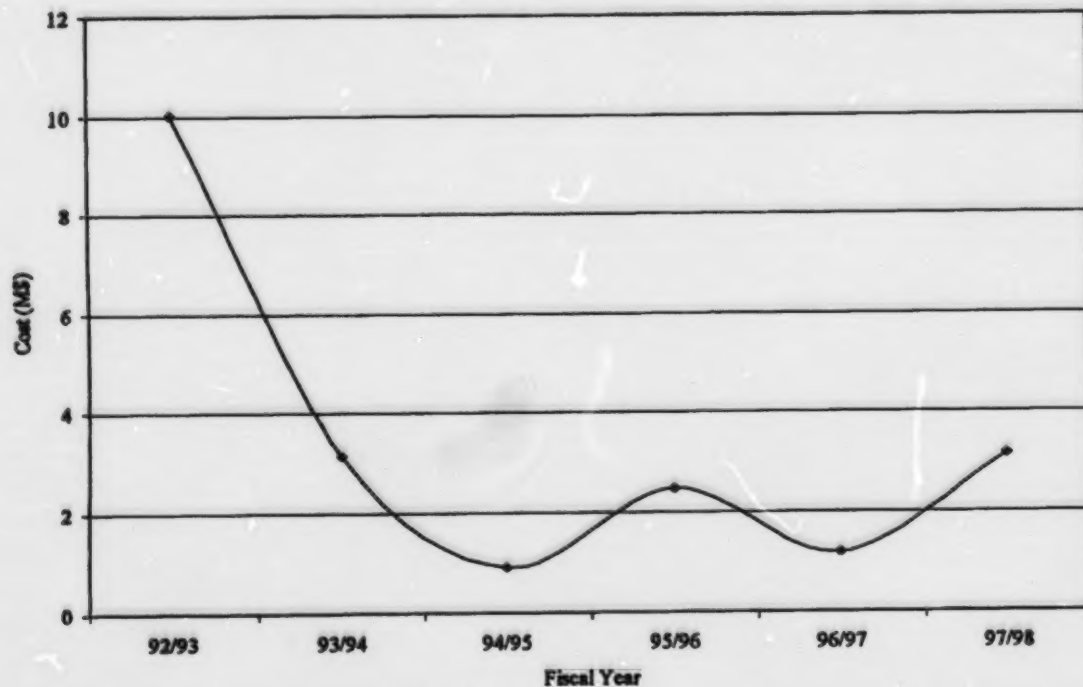


Figure 11: Total Cost per Fiscal Year

20. Since there is considerable fluctuation in activities every year, a comparison of different options was done using the demand of FY 96-97 (the most recent full year of information), and expressing all the results in dollars of FY 96-97. In FY 96-97 the total cost in railcar transportation was 1.19M\$, and a total of 482 railcars were used. This analysis of options is limited by the difficulty in getting cost figures from railway companies. The analysis, though limited, is meant to help make the best decision between different options. It relies on the main differences between the options rather than actually giving precise estimates of each option. Three options are looked at: the status quo i.e. hiring railcars as needed, a long term lease, and ownership.

21. For each option, the total annual cost of railcar transportation is calculated as the sum of the annual cost of having railcars in possession and the annual cost of using them:

$$\begin{array}{lcl} \text{total cost of} & = & \text{cost of having railcars} + \text{cost of using the} \\ \text{railcar transportation} & & \text{in possession} \quad \text{railcars.} \end{array}$$

The cost of using the railcars is more or less the same no matter which of the three options is considered. It includes the cost of transportation per se, administration, railway use, etc. It varies with the size and frequency of shipments. However the cost of having the railcars in possession varies depending on the option considered.

22. Hiring as needed. The cost of having a railcar when one is hired as needed represents 20\$ per day. The number of days in possession have not been compiled in recent years including FY 96-97, however 2 and 5 days were chosen (in consultation with the J4 Mov point of contact) as lower and upper bounds respectively. Thus the annual cost of having railcars in (temporary) possession in FY 96-97 would probably be between

$$2 \times 482 \times 20\$/\text{day/car} = 19\,280\$$$

and

$$5 \times 482 \times 20\$/\text{day/car} = 48\,200\$.$$

For a total transportation cost of 1.19 M\$, the cost of possession represents between 1.6% and 4.1% of that cost. This cost of possession varies considerably with the amount of railcar activity when hiring as needed.

23. Buying or long term lease? Owning railcars means the CF have to purchase them and maintain them in addition to the costs incurred when they are used. Depending on whether the CF own or rent, the annual costs can be further broken down as follows:

$$\begin{array}{lcl} \text{cost of having railcars} & = & \text{purchase cost or} + \text{cost of maintenance} \\ \text{in possession} & & \text{rental cost} \end{array}$$

The cost of buying a 60 foot flat bed railcar is 60 000 US\$⁴. The life of a railcar is estimated to be 40 years. A conservative figure would be to consider 20 years to represent the useful life of a railcar (so that the maintenance costs do not become excessive). The annual capital cost of a railcar would thus be $60\,000\text{ US\$}/20 = 3\,000\text{ US\$}$. A five-year lease not including maintenance was quoted⁵ at 400 US\$/month i.e. 4 800 US\$/year, greater than 3 000 US\$. This excludes the overhead costs involved in purchasing or leasing. Thus buying is less expensive than the long term lease.

24. Buying. How would the cost of possession in FY 96-97 (between 19 280\$ and 48 200\$) -- when railcars are hired as needed -- compare to the equivalent cost of owning and maintaining 48 and 66 railcars (the numbers of railcars needed to reach a 60% and 70% level of confidence)?

The annual capital cost of a car is $3\,000\text{ US\$} \times 1.3609\text{ (exchange rate)} = 4\,083\text{ CAD\$}$.

The annual maintenance cost of a car is $2\,571\text{ US\$}^6 \times 1.3631\text{ (exchange rate)} = 3\,505\text{ CAD\$} \times 1.029\text{ (inflation rate)} [6] = 3\,607\$$.

Then the total annual cost of capital and maintenance for a car is 7 690\$.

The total annual cost of possession for 48 railcars is $48 \times 7\,690\$ = 369\,120\$$ and for 66 railcars, it is $66 \times 7\,690\$ = 507\,540\$$.

The costs for the three different options for FY 96-97 are presented in Table III.

⁴ The source for this figure is Trailer Train Co.

⁵ Green Brier Leasing in Portland, Oregon.

⁶ Association of American railroads, Uniform Rail Costing System, average general flatcar maintenance expense for 1995. This includes repair, administration, structures (shops), small tools, preventive maintenance, etc. This is an average expense taken over all US flatcars (old and new) for 1995.

TABLE III
COSTS OF THREE DIFFERENT OPTIONS FOR FY 96-97

\$	Hiring as needed	Long Term Lease		Ownership	
		48 railcars	66 railcars	48 railcars	66 railcars
Cost of Having		48 x (6532.32+3607)	66 x (6532.32+3607)	48 x (4083 + 3607)	66 x (4083 + 3607)
		=	=	=	=
	[19 280, 48 200]	486 687	669 195	369 120	507 540
Cost of Using	[1 137 018, 1 165 938]	[1 137 018, 1 165 938]	[1 137 018, 1 165 938]	[1 137 018, 1 165 938]	[1 137 018, 1 165 938]
Total Cost	1 185 218	[1 623 705, 1 652 625]	[1 806 213, 1 835 133]	[1 506 138, 1 535 058]	[1 644 558, 1 673 478]

This cost of possession in the ownership option is more than 10 times the cost of possession incurred in FY 96-97 (hiring as needed), it is about 25% to 30 % of the total cost of railcar transportation in that year. However this cost does not depend so much on railcars usage. If the demand had been higher, say for 1441 railcars as in FY 93-94 then the cost of possession when hiring as required would have been between 57 640\$ and 144 100\$ i.e. closer to 5 times lower than the ownership option. Moreover, the cost of owning and maintaining 48 railcars and 66 railcars would then represent only 10% and 13% of the total transportation cost i.e. 3.15M\$ inflated and adjusted.

25. Henceforth the annual cost of owning and maintaining 48 or 66 railcars may appear large in comparison with the cost of possession of hired as needed railcars particularly for those years when rail transport is not used much. In years when many railcars are needed such as in FY 93-94, the cost of owning and maintaining represents a small portion of the total transportation costs (approximately 10%).

26. To sum up, three options were compared from a cost point of view:

- a. The status quo i.e. hiring railcars as needed, the major drawback being the availability of railcars or lack thereof;

- b. A long term lease, it is the most expensive option but it is not all that much more expensive than the ownership option. The railcars have to be maintained and managed⁷; and
- c. The ownership option: it requires a substantial investment (60 000 US\$ x 1.3609 x number of railcars purchased). The railcars have to be maintained and managed⁷.

27. One way to maximise the CF usage of CF owned railcars would be, besides leasing them to the railway companies, to divert part of the materiel currently transported by tractor trailers to railcars. Moreover, consideration should be given to buying used railcars. If they are not too old, they might bring down the annual cost of ownership for the remaining years of their lives.

28. Railway companies did not provide a price for the guaranteed availability of x railcars. This would be the easiest way for the CF to insure the availability needed when hiring railcars. Table III provides some idea of the price that could be negotiated say 200 000\$ a year to be guaranteed 50 railcars. However the Canadian railway companies often hire the railcars needed from large American companies such as Trailer Train Co. So they may find themselves in the same dilemma as the CF.

29. A visit to a railcar manufacturer located in Montréal i.e. GEC ALSTHOM AMF Transport provided some information on new 89 foot long flatcars. The life of these railcars is 50 years and their price is 115 000 US\$ (FY 96-97) each. But using a 25 year life expectancy with calculations similar to those of para. 24 we get:

$$(115\,000\text{ US\$}/25) \times 1.3609 (\text{exchange rate}) + 3\,607 \$ (\text{annual maintenance}) = 9\,867 \$$$

for the cost of owning a single 89' railcar.

30. These railcars being larger, one should need fewer of them to transport the same quantity of materiel. 48 railcars of 60' are roughly equivalent to 32 railcars of 89'⁸ while 66 railcars of 60' are equivalent to 44 railcars of 89'. The difference in terms of annual cost is shown in Table IV.

⁷ This relies on the availability of locomotives which is not a problem at this time for the industry.

⁸ This equivalence is based on footage. However an 89' railcar could carry two tanks while a 60' railcar could carry only one with nothing else on board, for balance.

TABLE IV
COSTS OF OWNING 60' RAILCARS COMPARED TO 89' RAILCARS
(FY 96-97)

\$	60% level of confidence in meeting CF requirements		70% level of confidence in meeting CF requirements	
	48x60'	32x89'	66x60'	44x89'
Cost of Owning	369 120	315 744	507 540	434 148

It is a little less expensive with the equivalent number of 89' railcars.

31. In practice the 115 000 US\$ price is valid if a manufacturer's line is built for a large number of railcars e.g. 200. If only 50 railcars are purchased, this would need to be done in conjunction with another buyer of the same railcars otherwise the price per car could be significantly higher.

32. A "lease to own option" offered by First Union Rail for 89' railcars at 115 000 US\$ would cost if say 44⁹ such railcars were considered, 1125 US\$/month/car for 10 years at which time the cars could be purchased at 67% to 75% of their original price. Which is equivalent to paying for the first 10 years twice the annual cost of owning them (estimated annual cost: 967 100 \$) from then on the annual cost of the railcars would be, when purchased, similar to the annual cost of the ownership option.

⁹ The price was actually given for 50 such railcars.

IV. CONCLUSION

33. Analysis of past information has shown that if the Canadian Forces want to respond to at least 60% of the demand in railcars, a minimum of 48 railcars (60 foot long) should be guaranteed. Information gathered from railway companies permitted the cost analysis of different options. The ownership option whether for 60 foot or 89 foot railcars is the least expensive option compared to a long term lease or a lease to own option. The annual ownership cost in FY 96-97 \$ for a 70% level of confidence in meeting the CF requirements is estimated at 507 540 \$ (for 66 railcars of 60') or 434 148 \$ (for 44 railcars of 89'). The lease option has the same inconveniences as the ownership option in terms of maintenance and management however it does not require the initial capital investment.

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ANNEX A
ORD RN-9804
MARCH 1998

OBSERVED CUMULATIVE DISTRIBUTIONS FOR THE NUMBER OF RAILCARS

Probability	Number of Railcars Needed for an exercise/operation (one way)	Number of Railcars Used per Month	Number of Railcars Used per Month for General Use
0.01	4	0	0
0.05	11	0	0
0.10	13	0	0
0.15	14	0	0
0.20	17	0	0
0.25	20	0	0
0.30	23	1	0
0.35	29	5	0
0.40	33	15	0
0.45	36	21	0
0.50	39	27	0
0.55	42	42	0
0.60	48	55	0
0.65	56	83	1
0.70	66	97	1
0.75	127	133	1
0.80	145	144	3
0.85	179	172	5
0.90	230	236	10
0.95	557	408	17
0.99	1326	1696	19

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DOCUMENT CONTROL DATA. (Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)		
1. ORIGINATOR (the name and address of the organization preparing the document. Organizations for whom the document was prepared e.g. Establishment Sponsoring a contractor's report, or tasking agency, are entered in Section 8). Director General, Operational Research Department of National Defence Ottawa, Ontario	2. SECURITY CLASSIFICATION (overall security classification of the document, including special warning terms if applicable) UNCLASSIFIED	
3. TITLE (the complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C or U) in parentheses after the title) TRANSPORTATION BY RAILCARS: A STUDY OF OPTIONS		
4. AUTHORS (last name, first name, middle initial) PROVENCHER, M.		
5. DATE OF PUBLICATION (month Year of Publication of document) MARCH 1998	6a. NO OF PAGES (total containing information. Include Annexes, Appendices, etc.) 27	6b. NO OF REFS (total cited in document) 7
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8. SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development. Include the address). J4 Mov		
9a. PROJECT OR GRANT NO. (if appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant.) 3561-LDO-G	9b. CONTRACT NO. (if appropriate, the applicable number under which the document was written.)	
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Currently the Canadian Forces (CF) use railcars from railway companies to transport materiel over long distances. In the last couple of years the availability of railcars has been lacking. During the recent Manitoba floods in the spring of 1997, some vehicles had to be driven to their destination. This paper presents a study of the CF past usage of railcars and an analysis of different cost options. It shows that the CF should be guaranteed a minimum of 48 (60 foot long) railcars in order to be able to respond to 60% of the demand.

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railcar
cost analysis
operation
exercise
availability of railcars
transportation
lease versus buy